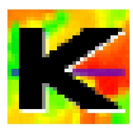
# *Exercise 14*
# Interpolate Series Map from Vector Data

## *About this exercise and the data set*

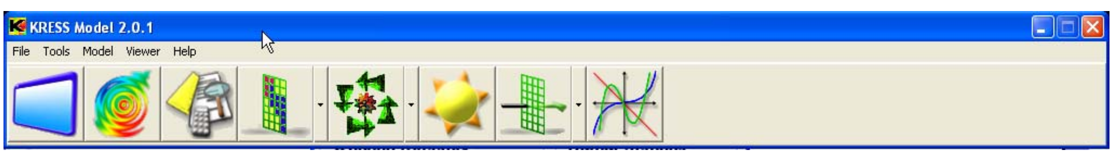
The data set used in this exercise is taken with permission from Dr. David Ganskopp, ARS Burns District, Oregon. The data was collected using thermistors. Thermistors were laid out in a grid sampling at the Squaw Butte experimental stations. Temperature data was collected every 15 minutes during the month of April 2001. The objective of the analysis is to map temperature variability in space (across the landscape) and in time (i.e. day versus night). We will compare temperature in high and low altitude areas.

### Step 1: Starting the KRESS Program

To start running the Model, double-click on the KRESS application icon.



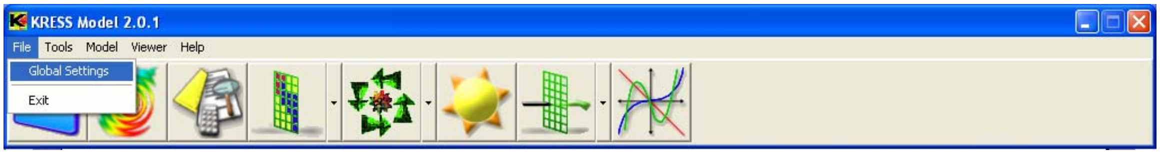
This will automatically load the KRESS Model program.



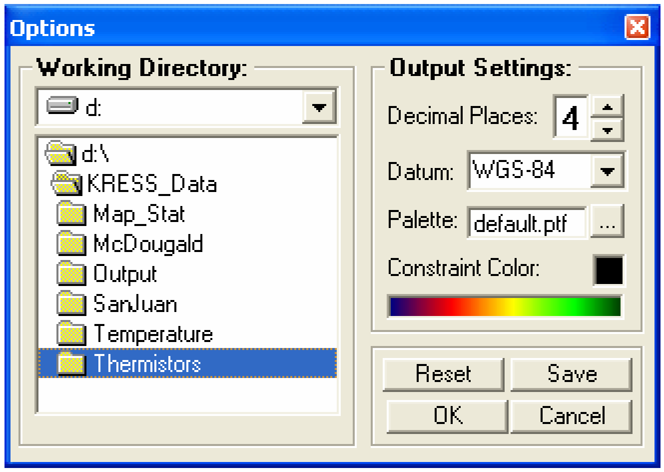

### Step 2: Setting the Working Directory

A project is a compilation of data files. Therefore, it is necessary to create a "Working Directory". This is the most fundamental element in organizing data files; both the input files to be used and the output files subsequently created by you, as well as your written analysis results. Creating a working directory activates the "Project Environment" module, allowing you to set the data paths of your file folders.

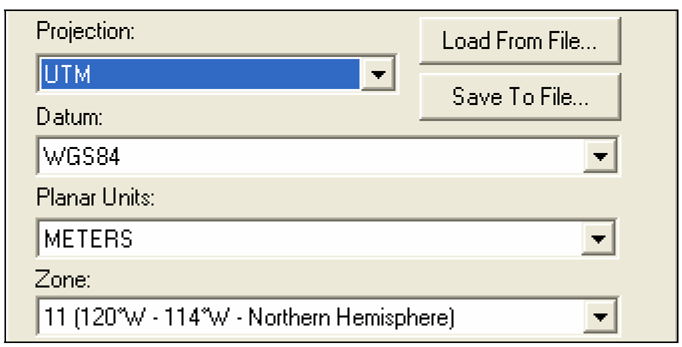
In order to access the working directory, go to the drop-down menu labeled "File" and then select "Global Settings" as pictured below.




Set your working directory to where you have saved your data.



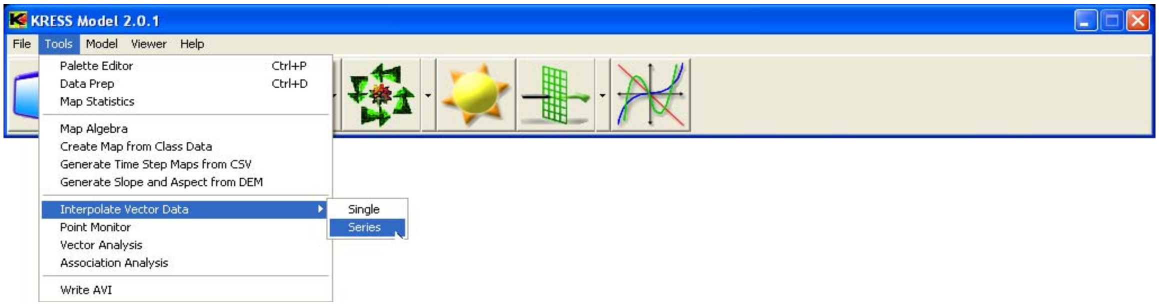

The projection for this data set is shown in the window below:



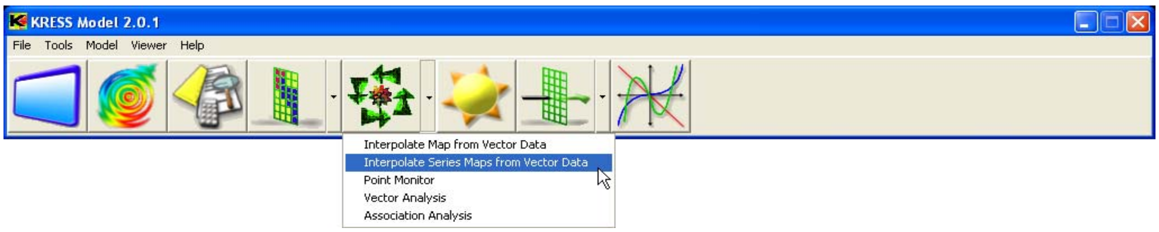

Source: GlobalMapper Software

## Step 3: Opening the Interpolate Vector Data Window

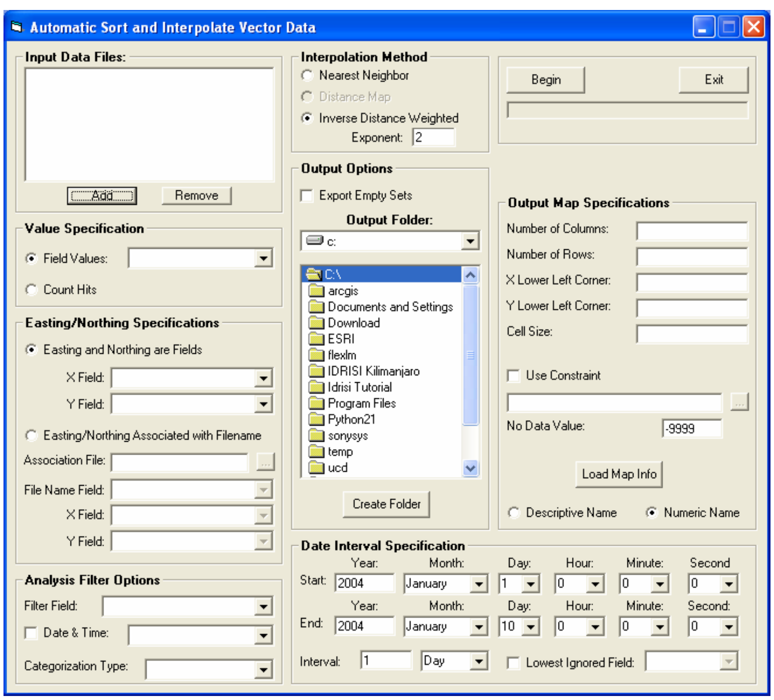
From the drop down menu labeled Tools select “Interpolate Vector Data” and then “Series”.




You can also access this from the vector tools button.



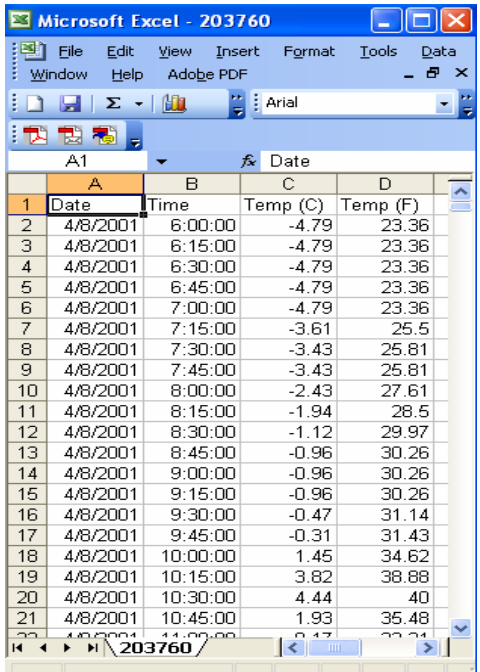

This will open a new window entitled “Automatic Sort and Interpolate Vector Data”.



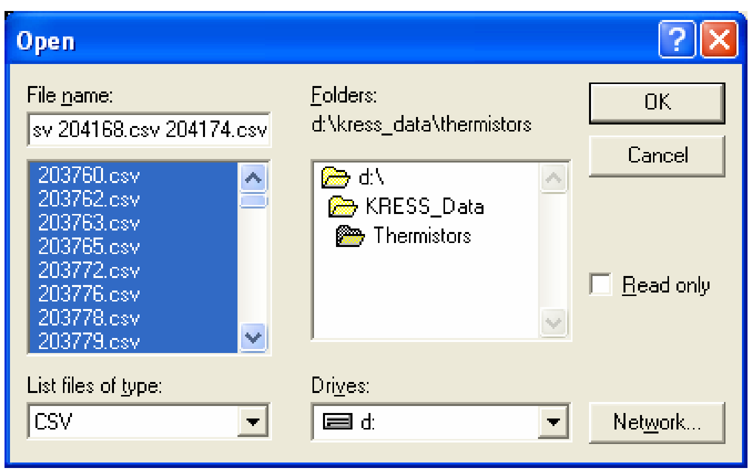

In the next steps we will fill in the necessary information for this window.

## Step 4: Inputting Data Files

The input data file requires a comma delimited text file, or "CSV". To see the content of this type of file, open a CSV file using Microsoft excel.  Each file was labeled using the thermistors ID. The file contains Date, Time, and Temperature in Degrees Celsius and Fahrenheit.

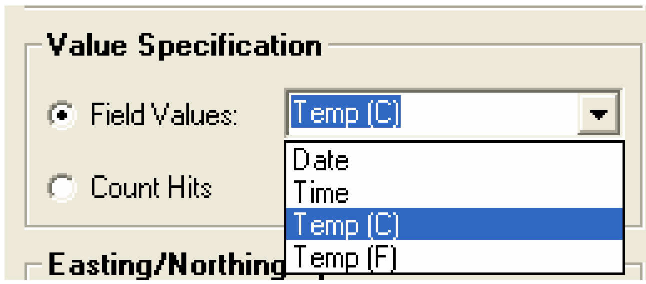



Click on "Add" to insert all CSV files. To select all files, click on the first file then hold the shift key and scroll all the way down.



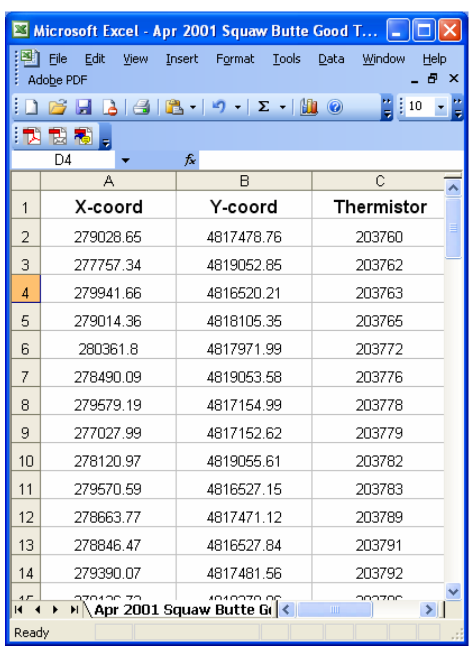

## Step 5: Value Specification

Once the data is loaded, it will show up in the input data files. Next, under the "Value Specification" and from the "Field Values" choices select "Temp (C)". We would like to use Celsius value for our maps.



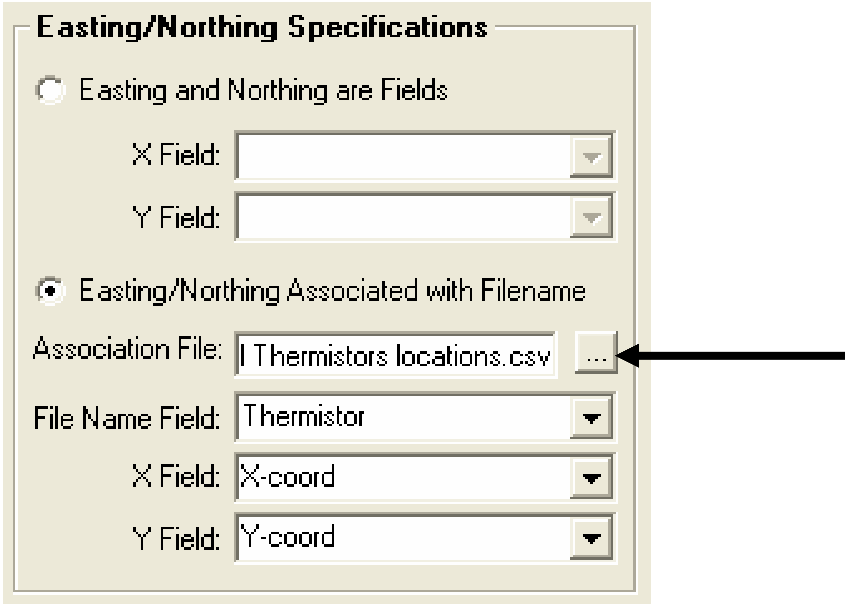

## Step 6: Easting/Northing Specification

We need to indicate where in the landscape our thermistors are located. For this step we recorded the exact location (± 1-2m) of every thermistor with a Trimble XRS Pro GPS unit. The data was saved as a comma delimited text file "CSV" under the name of Apr 2002 Squaw Butte Thermistors Location. You can open this file in MS Excel. The file contains three columns. Each row has the thermistor ID tied to X and Y locations.



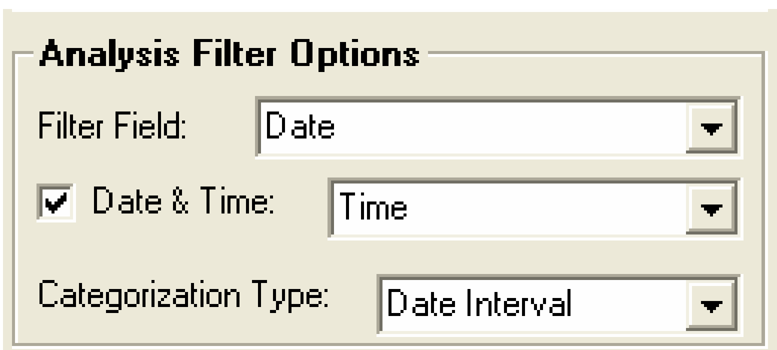
| X-coord | Y-coord | Thermistor |
|---|---|---|
| 279028.65 | 4817478.76 | 203760 |
| 277757.34 | 4819052.85 | 203762 |
| 279941.66 | 4816520.21 | 203763 |
| 279014.36 | 4818105.35 | 203765 |
| 280361.8 | 4817971.99 | 203772 |
| 278490.09 | 4819053.58 | 203776 |
| 279579.19 | 4817154.99 | 203778 |
| 277027.99 | 4817152.62 | 203779 |
| 278120.97 | 4819055.61 | 203782 |
| 279570.59 | 4816527.15 | 203783 |
| 278663.77 | 4817471.12 | 203789 |
| 278846.47 | 4816527.84 | 203791 |
| 279390.07 | 4817481.56 | 203792 |

Click on the "…" association file. Then fill in the information required as shown below:




## Step 7: Analysis Filter Options

The thermistors recorded temperature every 15 minutes for the duration of the study. In this step we can use a filter option based on the date and time to select a particular window to perform our analysis. Other option would be to select fewer thermistors to run the analysis. Fill in the information as shown below.

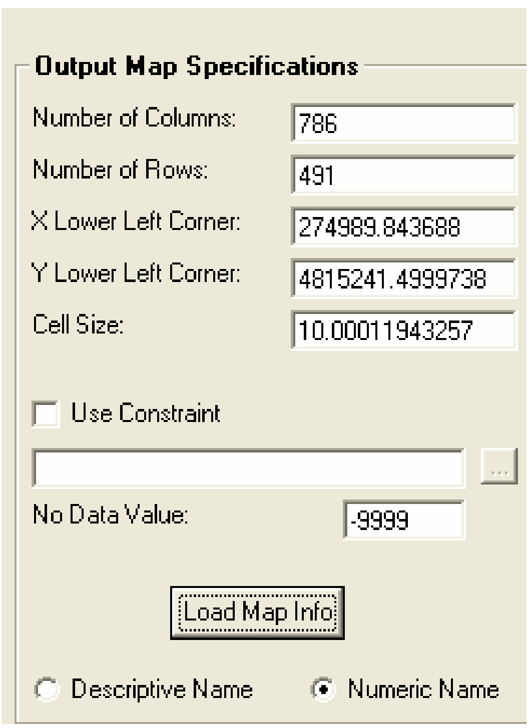


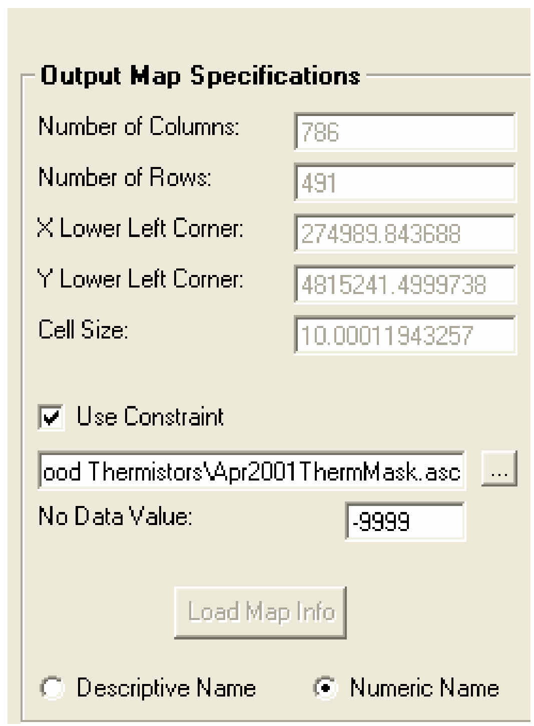

## Step 8: Output Map Specifications

In this step we would like to specify the spatial parameters of the image to be created. You may choose one of the following three options:

1. Copy spatial parameters from an existing image. To do this you need to click on the Load Map Info button.
2. Use a constraint file.
3. Define spatial parameters individually. If you choose this option you need to enter the number of columns and rows of the output image, the minimum and maximum coordinates in the X and Y dimensions, and specify the cell size.

Since we have a mask we would choose the second option. Check the box next to "Use Constraint". Browse to the directory and select the Apr2001 ThermMask. The spatial parameters from the mask file will be copied.



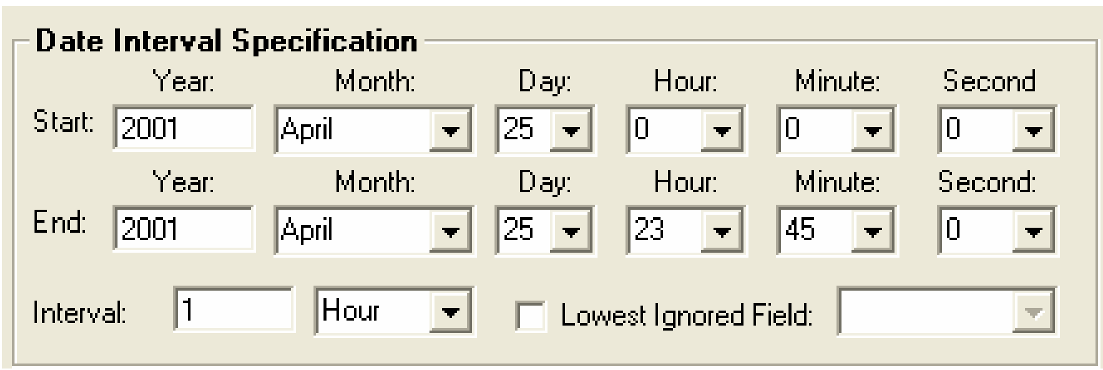



At the bottom of the output map specifications there are two options for labeling generated maps:

- “Descriptive” will label the output with alphabetical prefixes.
- “Numeric” will label the output using numeric or numbers prefixes.

## Step 9: Date Interval Specification

This step is linked to step 6 where we decided to use data and time as a filter. In this window we enter the specific date and time we want the model to run.
We will run the model for a 24 hour period. Select April 25, 2001, starting at midnight and ending at 11:45 pm, and choose an interval of 1 hour.

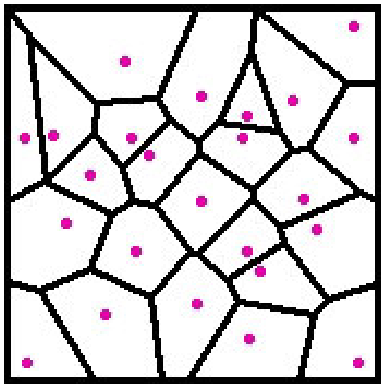



## Step 10: Interpolation Method

Interpolation is a mathematical process of estimating the value of a surface in locations where the values are unknown, based on the known values of nearby "control" points. Interpolation is commonly used to identify and map spatial patterns across a landscape.
The KRESS modeler can interpolate point data using one of three techniques:

### 1.Nearest Neighbor

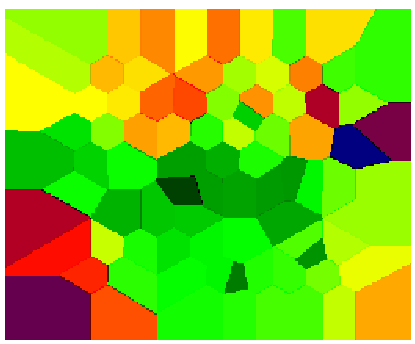
If you take a set of points and connect each point to its nearest neighbor, you have what's called a triangulated irregular network (TIN). If you bisect each connecting line segment perpendicularly and create closed polygons with the perpendicular bisectors, the result will be a set of Thiessen polygons. The area contained in each polygon is closer to the point on which the polygon is based than to any other point in the dataset.



Thus, the nearest neighbor interpolation technique defines the area of influence around a point that polygon boundaries are equidistant from neighboring points in the following manner:

- Join points to nearest neighbor in a triangular tessellation
- Compute perpendicular bisector
- Remove triangles

We should note that the size and shape of area depends on point distribution.



**2. Inverse Distance Weighted**

The Inverse Distance Weighted (IDW) is a quick deterministic interpolator. Which mean it is directly based on the surrounding measured values or on specified mathematical formulas that determine the smoothness of the resulting surface. The IDW interpolator assumes that each input point has a local influence that diminishes with distance. It weights the points closer to the processing cell greater than those farther away. It assumes variable decreases in influence with distance from sampled location. In another word, observations located close together tend to be more alike than observations far apart.

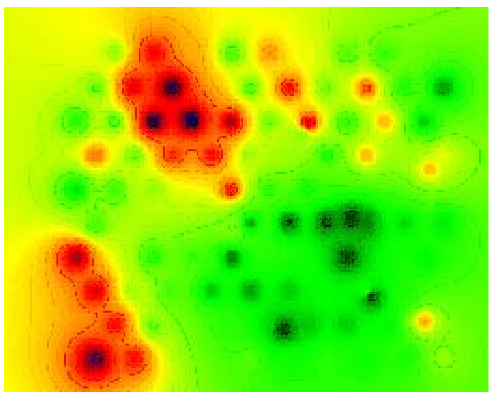
$$Z_0 = \frac{\sum_{i=1}^{n} w_i z_i}{\sum_{i=1}^{n} w_i}$$

Where: $Z_0$ = value of estimation point

$Z_i$ = value of neighboring point

$W_i$ = weighting factor; e.g. = 1/(distance from neighbor)$^2$

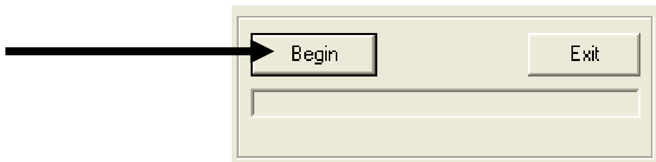
However, using IDW there is no assessment of prediction errors, and IDW can produce “bull’s eyes” around data locations.



The exponent parameter influences the weighting of the measured location’s value on the prediction location’s value. In other words, as the distance increases between the thermistor locations (known temperature) and the prediction location, the weight (or influence) that the measured temperature point will have on the prediction will decrease exponentially.

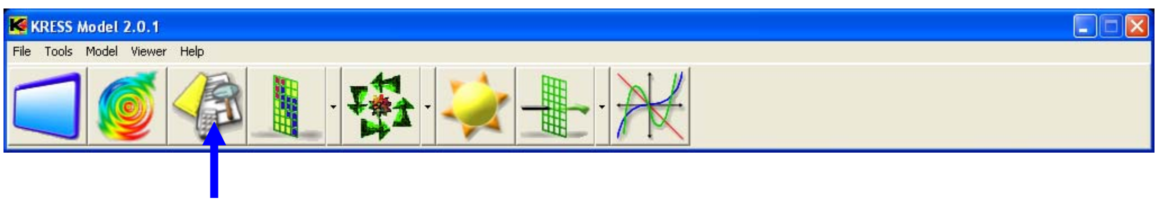
## Step 11: Running the Interpolation Technique

Once you have decided which interpolation method you would like to run, you are ready to run the analysis by clicking on the "Begin" button. **This process may take several hours, depending on the number of maps being interpolated**. (About 8 to 10 minutes per map.)

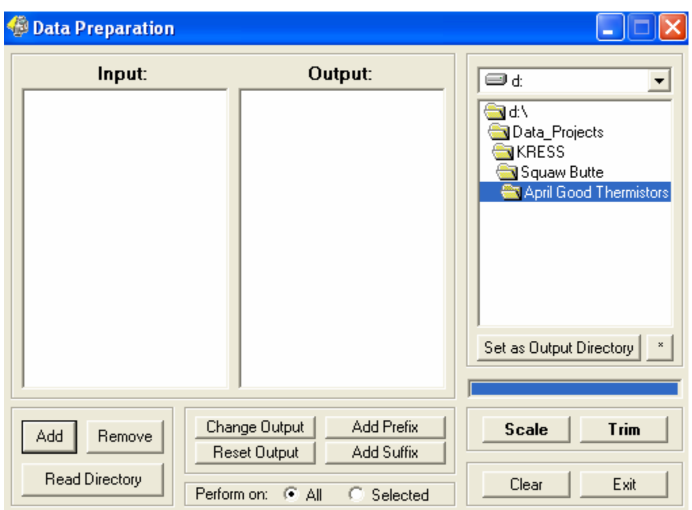



## Step 12: Scaling the Data

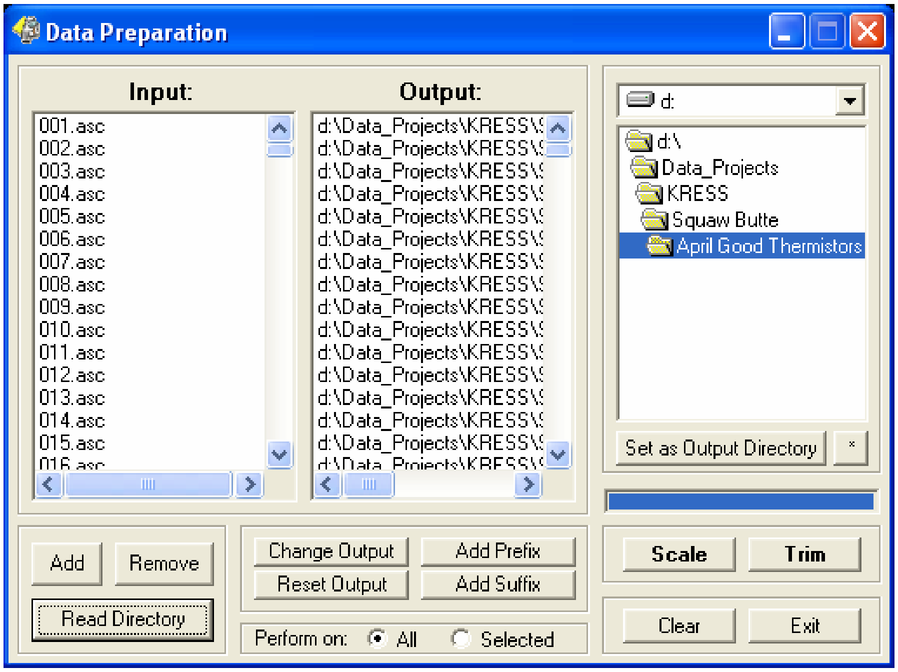
Open the "Data Preparation" window



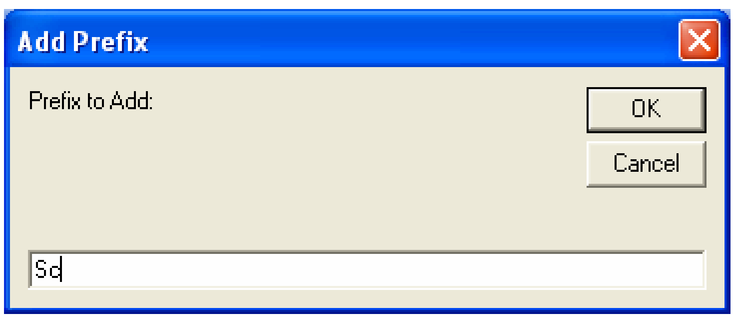

A new window will open:




Click on "Read Directory"



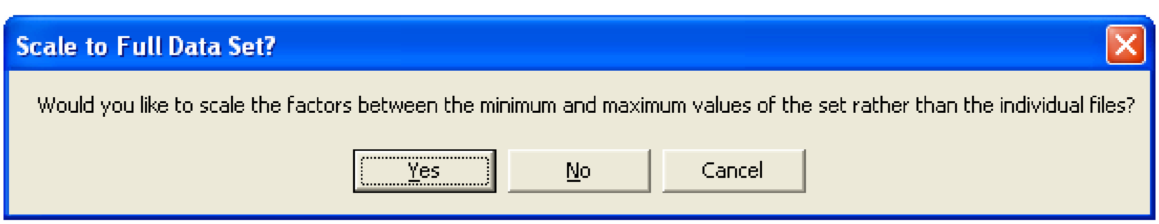

Click on "Add Prefix". A new window will open; type in Sc for Scaled data.

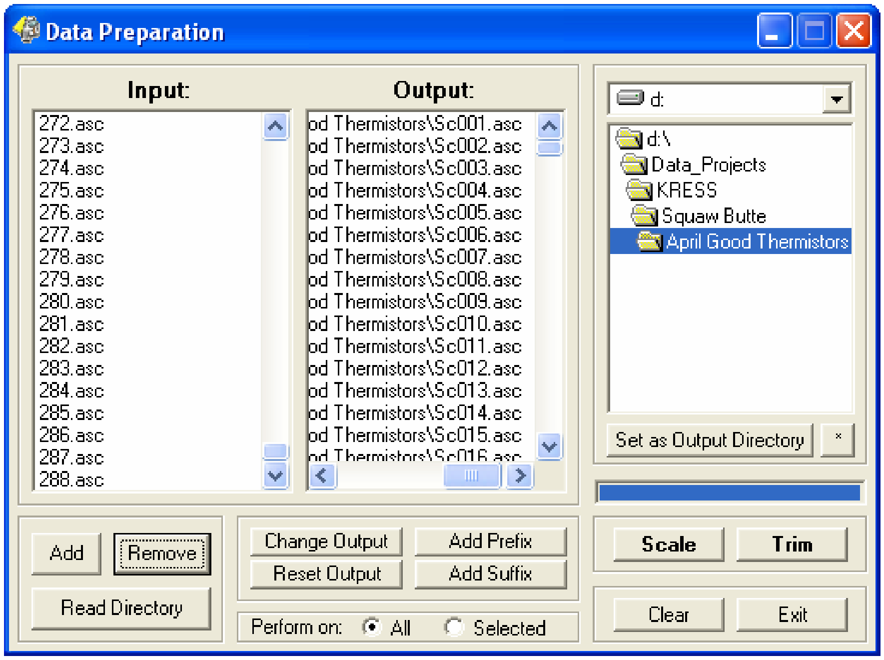



Now you are ready to scale your data. Click on the "Scale" button.

The next window "Scale to Full Data Set" will ask you if you would like to scale the factors between the minimum and maximum values of the set rather than the individual files.

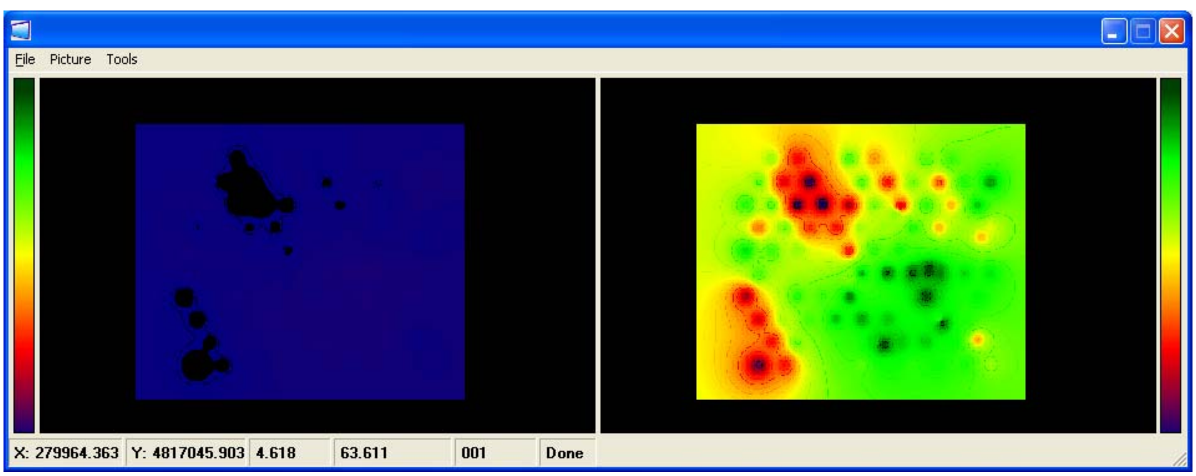
Click "Yes".



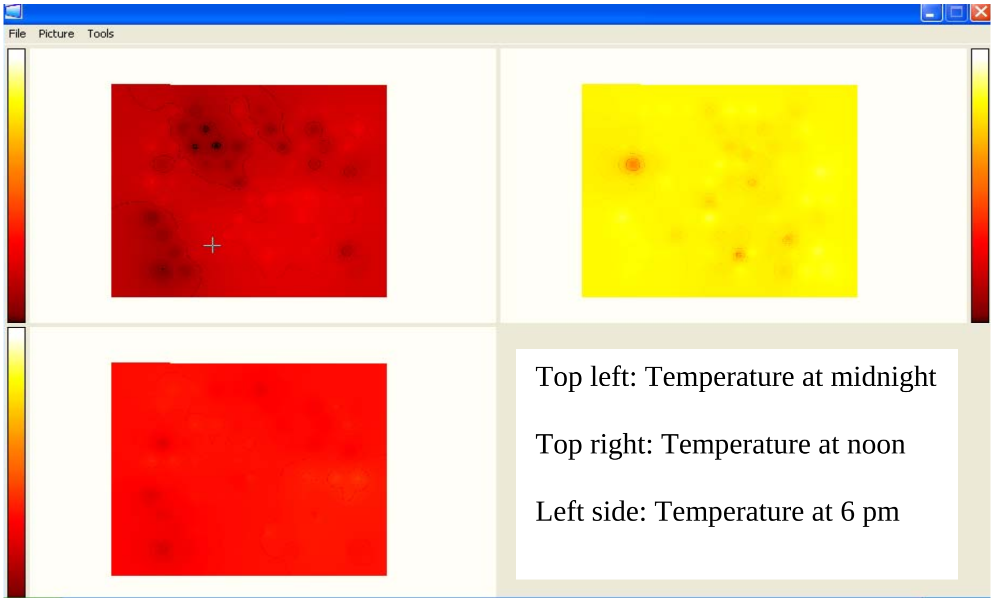



## Step 13: Viewing Your Output Maps

Use the viewer to display side by side an image before and after it was scaled.

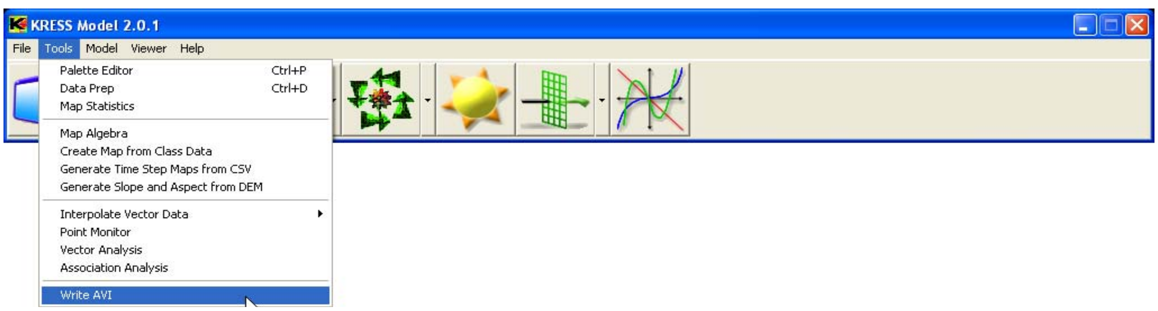


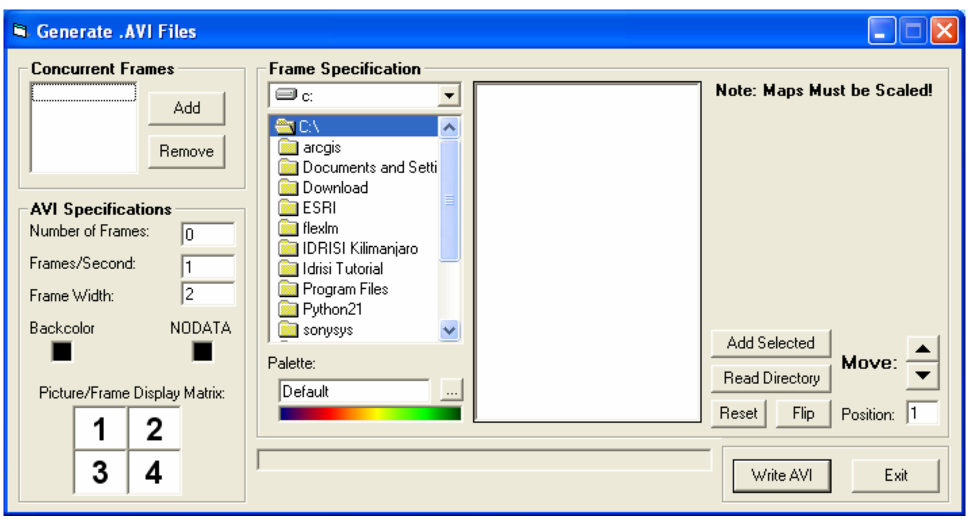

You can also display a sequence of maps, as shown below:




## Step 14: Generating an AVI File

From the tool menu click on “Write AVI”.



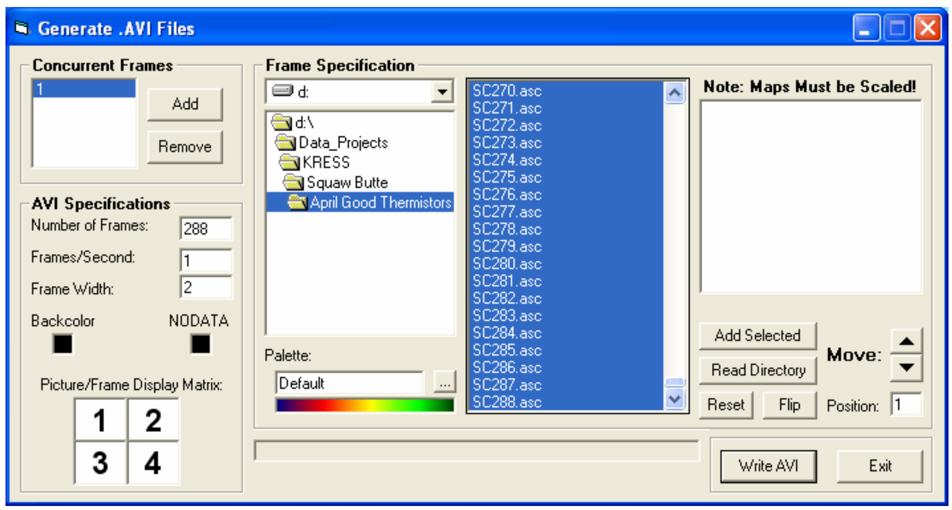
## Step 15: Filling in the AVI Specifications

Enter the number of frames: 288

Frames per second: 1(speed)

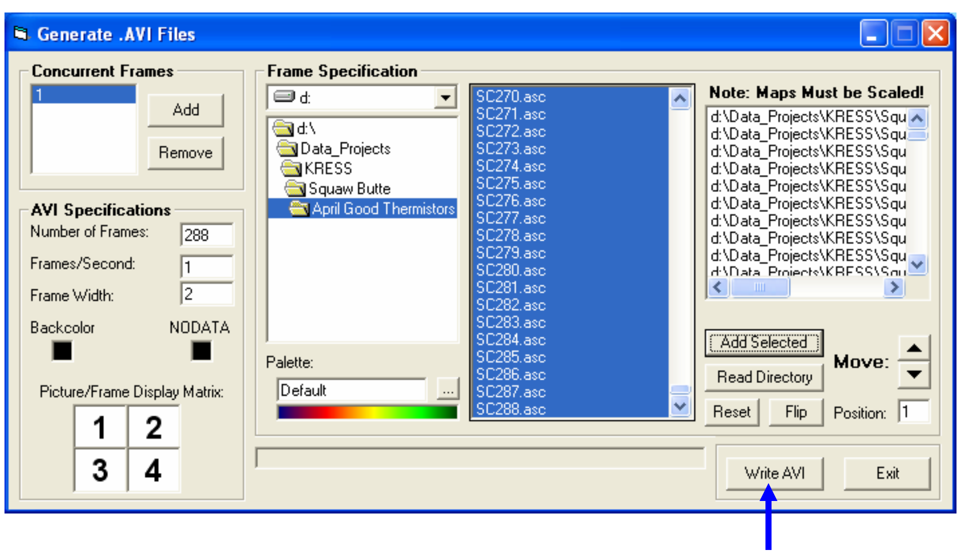
Frame width refers to the size of the pixel.  "2" would double the size of every pixel.

Select the scaled files and click on "Add Selected".




## Step 16: Write AVI

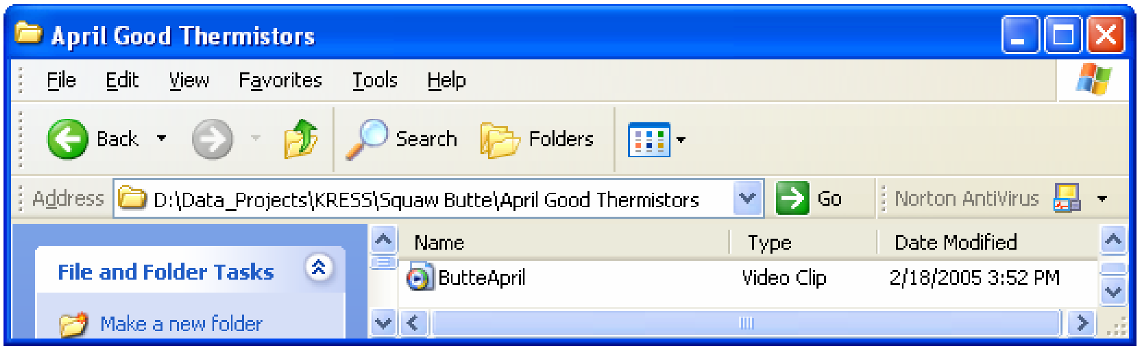
Now you are ready to write your AVI.  **This process may also take several hours (depending on the number of maps).**




This process can take up to 3 hours to run.

## Step 17: Playing the AVI

Browse to where you have saved your AVI.




Double click on the file and the AVI should play the movie.